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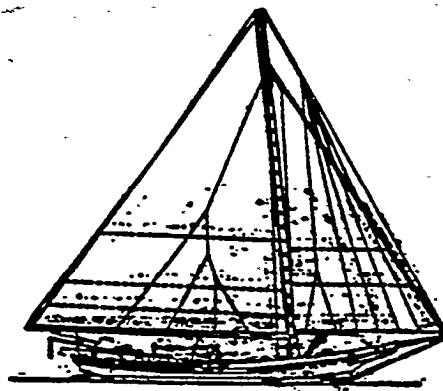
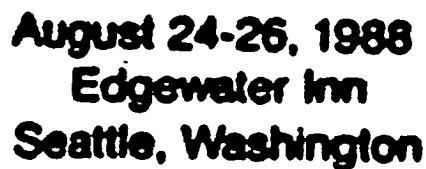
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Improvements in Productivity Through Staff Integration

No. 4A

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Abstract

Too frequently, today's shipyards are a product of their history. Their organizations represent the experiences and successes of the personnel. In the past this has been adequate because the maritime business was largely subsidized by federal government programs. Reductions in these programs have directly reduced the business available to shipyards. As a result, shipyards are failing at a record rate. The prognosis is not good.

This paper addresses one facet of improving a shipyard's position in an increasingly competitive environment improvements in overall productivity resulting from integration of the functions of the shipyard staff. First, an organization is described, identifying the staff and defining its purpose within the shipyard. In a typical shipyard, the staff includes organizations for estimating, planning, engineering, purchasing, and contracting. The responsibilities of each of these groups is discussed and, in particular, the areas of interface between them are highlighted.

Using the information developed, the paper then examines known problems, based on shipyard experiences, which are responsible for reduced productivity. The paper then provides an outline for integration of staff functions, using simple process control and data processing which will reduce staff overhead and provide improved estimating, material flow, and scheduling support to Production.

Introduction

In 1878, as American enterprise was beginning to discover its place in the industrial revolution, an integrated shipyard was founded. Nathaniel Greene Herreshoff, hoping to get into the steam engine building business, joined his brother, John, with the provision that John would pay all the bills promptly, not borrow money for expansion or construction, and never undertake any work that would require more capital than was on hand. Although the agreement seems quaint today, everyone in this audience is familiar with the success of the Herreshoff Manufacturing Company.

Now, despite an ever-increasing world population and its demand for shipping, orders for new ships have dwindled. Five years ago, the west coast of the United States supported five major commercial shipyards and more than two dozen repair facilities. In 1988, only one shipyard has avoided Chapter 11 bankruptcy proceedings and a handful of repair yards remain. Shipyards throughout the country have imported expertise from around the world to improve their standing in the marketplace. By this time, most of the experts have gone home and the situation continues to worsen.

The purpose of this paper is to suggest a home-grown approach to the improvement of shipyard productivity within the narrow scope of the shipyard staff. For better understanding of the issues, it is necessary to define "productivity", and to review the typical modern shipyard organization. This paper will then identify the elements which made the Herreshoffs an integrated, successful organization. With that background, it will be possible to extrapolate the integrated approach into today's shipyards and demonstrate how the use of modern analytical and data management tools will permit managers to deal with increased detail without turning over control of the shipyard to disparate entities.

Productivity

Productivity is much like the weather: everyone talks about it, but no one does much about it. Perhaps this is because there is a lack of understanding. For example, it is simple to put up a barometer, a thermometer, and an anemometer to collect a few data points. But these are not likely to provide enough information to permit an understanding of the phenomenon. Similarly, to understand productivity, it may be helpful to collect data; it is essential to know how the data is to be correlated.

First, there must be an agreement about what productivity is, and how it is to be quantified. In general terms, productivity is the quality of creating goods, benefits and services. This paper will use a more quantitative definition: the ratio of the value received for the end product to the total cost of producing that end product.

Usually, there is not much disagreement about the numerator of that ratio. Except for change orders and claims, its value is known when the contract is signed. Therefore, in order to maximize the ratio during the post award period, shipyard management must effectively reduce the denominator.

The elements of the denominator are the cost of materials, the cost of the labor to assemble those materials, the cost of the facilities in which the assembly takes place, and the cost of the staff required to coordinate the entire process. Each of these elements needs to be considered separately, but such a study is beyond the scope of this paper.

For the purposes here, it will be assumed that the cost of materials and cost of facilities are simple quantities, varying from shipyard to shipyard by some small constant. Labor rates paid to the staff and production workers are, of course, highly variable. This paper intends to provide recommendations which will result in a reduction of the personnel costs which make up a large part of the denominator.

The Modern American Shipyard

In a modern American shipyard, the shipbuilding function is divided into many sub-functions, each with its own requirements and, too frequently, each with its own ends. There are probably as many organization charts for shipyards as there are shipyard vice-presidents. It is the intent of this section to describe a generic organization which approximates all the others.

The organization of the typical modern American shipyard has two weaknesses. First, the organization is often dictated by the personnel available, rather than the functions to be performed. Secondly, staff selection is based on personal relationships more than personal competence. Shipyard repair organizations abound with these "Good-Ole-Boy" relationships.

In the operation of a shipyard, there are functions which are strictly related to the end product, be it a new hull or a repair. At the same time, there are many functions which are necessary as a part of doing business and which have no specific relationship to production. Organizing the staff solely to support the project is inefficient overall because of the unique character of the project and the personnel responsible for it. Likewise, organizing for support of the administrative requirements is generally unresponsive to the needs of the projects, which are life's breath to the shipyards.

By this time, most American shipyards have attempted to create a sort of hybrid organization to serve the apparently divergent needs of projects and administration. By and large, these organizations have been carefully thought out by upper management. They are tailored to suit the particular strengths of the middle managers and staff which are present in each shipyard. Unfortunately, the failure of matrix management systems is not a failure of concept, but a failure of im-

plementation. There are two reasons for this failure.

First, the middle management of nearly every shipyard in the United States has come from within. Not necessarily a bad thing in itself, this instills a "trade-oriented" view of the shipyard operation. As a result, there are lingering loyalties and biases within middle management which permit breakdowns in communications between functions.

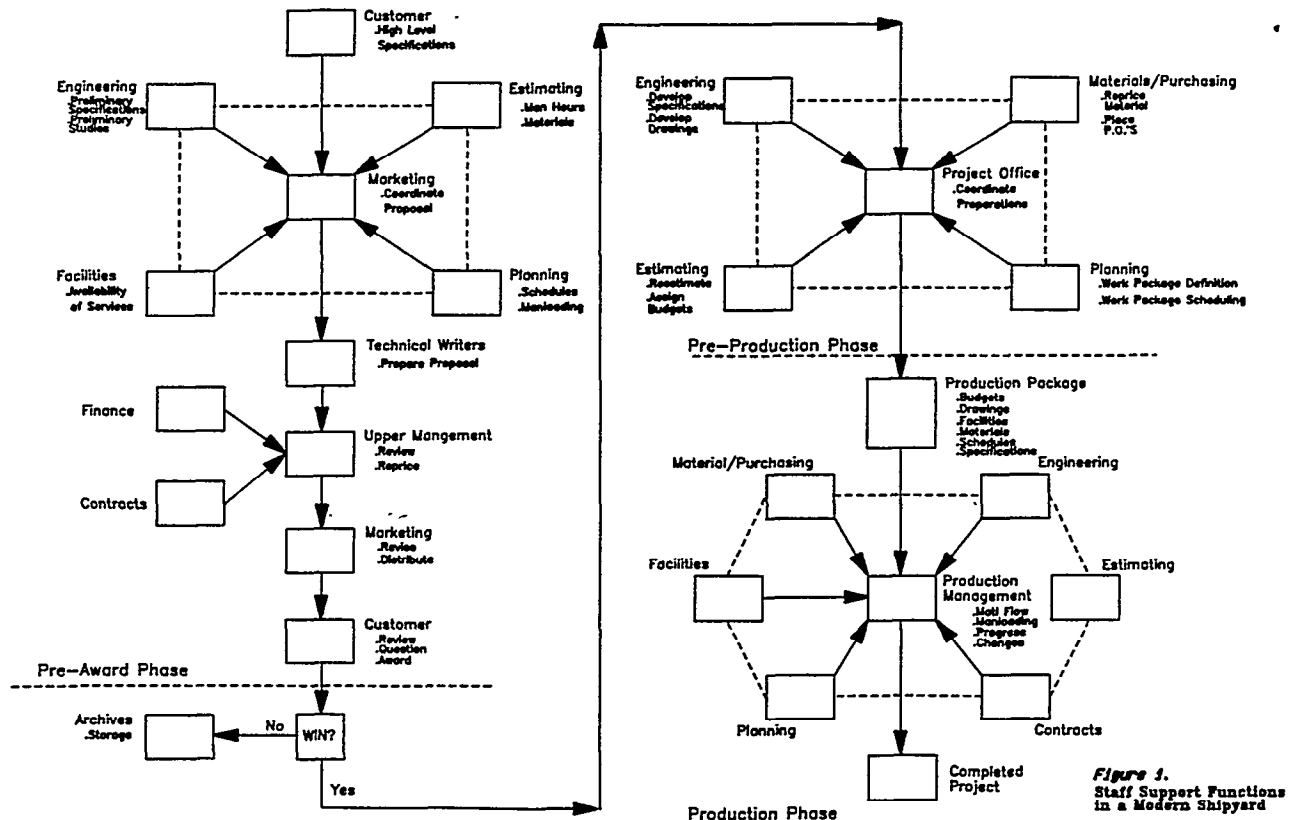
Second, staff organization is nearly always decided by upper management without reference to the staff. As a result, personnel are put into positions in which they have no real interest or talent, they have no sense of participation in their own destinies, and they judge that upper management is either ignorant of the true situation or doesn't care. As a result, the staff often continues to perform the same function, regardless of the organization, and the denominator of the productivity equation stubbornly refuses to get smaller.

Now, it is necessary to describe the functions which are to be performed by each segment of the middle management organization.

Contracts-Provides a legally competent interface between the shipyard and the customer. Is responsible for defining documentation requirements for matters such as change orders, accelerations, payments, and delays.

Engineering-Describes the end product (either a ship or a completed repair job) in terms of materials, specifications and producible elements. Describes the standards by which the end product is built and tested.

Estimating-Describes the end product in terms of total cost to complete- usually in manpower requirements, material costs, and facilities utilization.



Facilities-Maintains and provides the shop space, warehousing, erection areas, and utility services to support the construction of the end product.

Marketing-Coordinates the preliminary descriptions of middle management and presents them in a form which will be palatable to upper management and most attractive to the customer.

Materials/purchasing-Identifies materials and subcontractors which are required by the drawings and specifications; evaluates the cost of each alternative, selects material and subcontractor sources, negotiates final pricing and issue purchase orders to selected vendors.

Planning-Describes the process for assembly and installation of materials and producible elements within the construction time-frame.

Production-Using the materials, drawings, estimates and schedules provided by the staff, constructs the end product within the budget and schedule.

It should be noted that Production is not a staff function, but is a user of all the efforts of the staff. As a result, production personnel are almost completely dependent on the quality of the staff effort. Still, some shipyards evaluate their productivity only in terms of Production Department effort required to complete a particular job.

In order to evaluate the functioning of any mechanism, it is instructive to develop a model which describes the process which the mechanism performs. Figure 1 is a flow chart model of a shipyard. It describes the activities within the shipyard during one complete cycle-the construction of a ship. Since the central focus of this paper is to examine and integrate the workings of the staff, the figure emphasizes those at the expense of a more detailed examination of the production phase.

The process is started by the customer coming to the shipyard with a specification of work to be accomplished. This may be a high-level performance specification in the case of a new construction project, or detailed work specifications for a ship repair. Regardless, in most shipyards the process of developing a response to the customer is the same: Marketing parcels out areas of specific responsibility to each of the other staff groups. They, in turn, develop responses within their areas of expertise, working toward the schedules established by Marketing. Because of the compressed time frame allowed, all functions proceed more or less in parallel despite the obvious interdependencies. Furthermore, Production is virtually excluded from the pre-award phase of the shipbuilding process. As a result, production experience gained from previous contracts is not incorporated into the engineering and estimates for new efforts. This is particularly critical when developing proposals for Navy repair work: many of the work packages are virtually identical from ship to ship.

Meanwhile, Marketing hires an itinerant group of professional writers to create the shipyard's image by writing the technical proposal. In practice, of course, these relationships are longstanding; usually the technical writers are reasonably familiar with the shipyard organization and staff. Although this is generally desirable, there are two matters which to be considered. First, despite apparent familiarity with the shipyard and its operation, the consultant frequently describes technical details the way he believes they should be done, rather than as an actual process. Furthermore, the marketing staff is usually sufficiently removed from the shipyard that they will fail to detect the differences during their review. As a result, commitments may be made which later prove impossible to fulfill. Also, when the consultant has his purchase order in hand, the competition is over for him. From that point on, he has only to take the information provided by the shipyard staff and arrange it in the most attractive way; the outcome of the shipyard's competition is of interest only as future advertising.

About a month before the submittal date, shipyard upper management meets to review the proposal. In general, these reviews are limited

to two questions: have we committed to do something (such as reorganize our cost accounting system) which we are unwilling to do? And, do we need the work badly enough to take it on for this small a profit margin? Needless to say, there are a large number of considerations which go into these reviews, and those will not be addressed here. Most frequently, however, the Proposal emerges from the upper management review with significant editorial change and a direction to modify the pricing downward based on considerations of improved productivity. The proposal is then revised, printed, and submitted to the customer.

While the shipyard goes on to other things, the customer reviews the proposal, perhaps asks questions and, six weeks to six months later, may award a contract. If the generic shipyard loses, there is appropriate grumbling and internal recrimination and the proposal is retired to the archives.

If, however, the generic shipyard wins, there is brief elation followed by a period of questioning about just how the end product is to be created for the price. At this point, a new entity, the Project Office, is usually created. Personnel in the Project Office usually have not worked on the proposal, so are unfamiliar with its contents. The function of the Project Office is similar, in the pre-production phase, to that of Marketing in the pre-award phase. Instead of a deliverable package of proposal material, however, the Project Office will coordinate the development of a production package. This package will include all the budgets, drawings, facilities requirements, materials, schedules, and specifications which are required to accomplish the job.

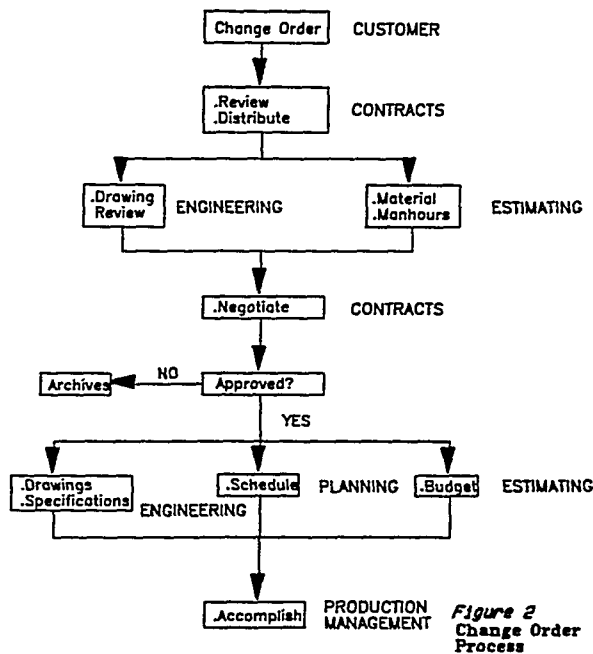
In developing this package, the entire project will be reestimated, repriced, and rescheduled. The proposal is now sent to the archives and supplanted by the new creation, and the result of any pre-award research which was done is lost to the shipyard. Again, because of time constraints, the functions which are serial in nature must be accomplished in parallel. This results in duplication of staff effort and discontinuities in the production package. At this stage, some shipyards begin to involve a few production foremen (particularly for engineering) to assist in selection of materials and lay-out for welding procedures.

Finally, the entire package is turned over to Production for accomplishment. Usually, the Project Office continues staffed to accommodate customer relations, monitor large-scale subcontracts, and coordinate between Production Management and the staff. In most shipyards, the Project Manager and the Production Manager report to different organizations, which results in differing priorities relative to the completion of the ship.

For example, Production is usually oriented to manpower and scheduling considerations; Project Management is usually concerned with contractual aspects. Figure 2 shows a typical sub-process the estimating and accomplishment of a change order. Frequently, the need for the change has originated with Production and, in that organization's view, the sooner it is completed, the better. Time is of the essence for Production because failure to accomplish this change is holding up progress on all subsequent steps in the process.

The staff, however, is concerned with assuring the change is properly documented and that the shipyard is adequately compensated. The customer, of course, has similar concerns. As a result, production is rescheduled around the staff efforts required to support that particular change. If no change is subsequently authorized, the scheduled time for that function may be irretrievably lost. Frequently, the schedule loss is more valuable than the cost of the change, but there is usually no compensation to the shipyard. As a result, the shipyard must file claims subsequent to delivery, making documentation essential and confirming the need for additional staff personnel.

One staff function which does not appear in Figure 1, but which has a profound effect on the shipyard's operation, is the data management system. Since the generic shipyard represents a typical ship-



yard, the data management system is under the purview of a staff manager whose background is in computer applications. The system provides support to engineering, accounting, payroll, materials, purchasing, personnel and production management. The system is outdated, and full of patches which have been installed to meet specific requirements for specific projects, most of which have been completed. There are access terminals throughout the shipyard, but they are used only by the anointed few. While management has great confidence in the voluminous reports the system produces, the same reports tend to gather dust in dark corners of production offices or are thrown away as soon as they arrive. On the average, management's confidence in these reports is undeserved, but so is the staff's disregard of them. Periodically, data management personnel venture into the shipyard to seek out grass roots suggestions, but they are met with sullen hostility, recommendations which are not in their power to implement, and/or misplaced enthusiasm from trade personnel who see an opportunity for themselves in a new and exciting field of endeavor.

Upper management personnel who wish to verify the effectiveness of their data processing system can easily do so by counting the number of personal computers which are seen throughout the yard. Each of these represents an independent data base—a failure of the existing system to meet the requirements for a truly integrated system. To be sure, there are specific applications which require the unusual security which is available because of the isolation of the personal computer, but these are relatively few.

Now some conclusions can be drawn about the process the generic shipyard uses to accomplish its work.

First, it has been shown that the various staff entities work essentially alone, isolated from other groups because of difference in function, time constraints and frequently, personal indifference. Each entity identifies with its function, rather than with its project. Each project is also isolated from all similar ones by a deliberate plan to avoid comparing estimates, drawings and specifications from one job to the next and by elimination of Production Department inputs during early phases of the process.

Second, it has been demonstrated that the staff bears no responsibility for the success or failure of a project because during the pre-award phase upper management modified estimates and projections without reference to staff; staff has no means of anticipating the im-

pact of contract changes, and there is no workable system to provide them with an evaluation of how well Production performed on the estimate or schedule.

This review of Figure 1 also makes it clear that the production phase is only the final step in a series, and that the productivity of the shipyard is as dependent upon the staff support as it is on production. The pre-award and pre-production phases provide the production worker with the tools he needs to accomplish his job; the better the tools, the better the job. The remainder of the paper will address improving these tools.

The Integrated Shipyard

It would be nice to say that responsibilities were neatly divided in the Herreshoff Manufacturing Company, but that would not be true. The only functional area in which one of the brothers was clearly in charge was engineering. Nat was the Chief Engineer largely because John was blind from the age of fourteen. In general, though, Captain Nat served as Chief Engineer, Chief Planner, and Head of Production. John directed the remaining staff functions and was senior partner until his death in 1915.

It appears that virtually all major decisions were jointly made by the brothers. To permit meaningful participation in the decision making process, both of them had to have access to all data which was critical to operation of the shipyard. Yet Captain Nat spent eight hours a day wandering through the production areas, supervising construction. And they never owned a single data terminal!

Without belaboring the Herreshoff brothers, there are three qualities which enabled them to fully integrate the operation of their shipyard. First, both were technically competent; they understood the workings of a steam engine as well as they understood the workings of the business in which they were involved. They could no more be misled by a craftsman than by a lumber merchant. Second, they had confidence in each other's integrity. Each was sure that the other had their mutual benefit in mind. And, although perquisites were certainly available (by 1885 they had built themselves a 94-foot steam yacht) they were never an end in themselves. Finally, they appreciated and respected their staff. It was their policy to hire the best personnel available, to pay them well, and to provide them with the necessary training. By consciously courting the employees, John, in particular, brought them into the company as mini-partners and earned a sense of loyalty which would not have been possible had he simply hired them.

The keys to creating and maintaining the integrated shipyard staff are much the same today as they were in the days of Captain Nat and John Herreshoff. Using these keys, the goal of upper management is to improve staff productivity in the development of the production package. The tools at their command include: eliminating redundancy in the organizational structure, upgrading personnel skills and performance levels, and improving staff utilization of capital-intensive systems. To achieve these goals, two major problems must be addressed: personnel and data management.

Both of these difficulties can be overcome by following four steps: evaluating, communicating, consolidating, and implementing. The paper describes each in general terms below. At each step, the manager should consider how he utilizes his technical competence, personal integrity, and regard for his staff.

Evaluating

First, what functions will the staff to perform? Figure 1 postulates an organization and specific functions done by each sector of the staff. Although that organization does not match that of any particular shipyard, it does reflect functions which are carried out by the staff. Management should carefully consider whether some of these functions might be better transferred to a trade-level organization because of their greater familiarity with production processes and materials. Management then needs to evaluate the personnel as-

signed to the staff. This evaluation must be based on two considerations: what the individual is presently doing to contribute to the productivity of the shipyard, and where his particular talents could be better utilized to improve productivity.

Having established the functions, the next matter of concern is the flow of information. Every shipyard has a well-established (but informal) system of communications. It is the telephone, the in-yard mail, and word-of-mouth. None of these accurately reflects the shipyard organization nor includes the data processing system. As a result, information critical to the staff is misdirected or lost and must repeatedly be regenerated. Since it is not efficient for all information to be available to all personnel, management must decide what the real information requirements are, and how they are to be provided.

In order to improve their productivity, the staff needs some tools with which to work. To minimize redundancies, they need the ability to file, retrieve, manipulate and transmit information readily. Upper management must determine which data is necessary to run the company. Then it must be determined where that data is presently located and how the present system can be streamlined to eliminate the superfluous. The most effective means available uses electronic data processing systems. The best data processing system is the smallest, most reliable and least expensive system which meets the company's need.

Communicating

In addition to hardware, the staff needs a good understanding of the plans management is implementing. Also, having worked with the present system for some time, they probably have some valuable insights and suggestions for modifications. By providing an open forum for the communication of management's goals, three important objectives can be achieved: the goals can be directly communicated; management can learn the lessons and gain the recommendations of those directly involved in day-to-day operations at the middle management level; the staff gains a sense of participation in their own destiny.

It would be naive to imply that all recommendations from the staff will be useful. Communication is a two-way process; upper management must provide the framework by establishing and maintaining a focus on the goals of the company. However, they must also be quick to recognize parochialism or self-serving interests within the staff, and be firm in setting these aside.

It is important that this entire process be public knowledge. This will encourage the staff by assuring them that management is aware of the true situation within the shipyard and is taking steps to rectify problems.

Consolidating

This audience is familiar with the basic principles of integration in terms of designing a circuit or system. First, the design must be based only on the functions to be performed. Wherever possible, functions should be combined to minimize the number of components. Communication lines should be shortened to reduce lost time and assure accurate transmission of information. Necessary supplemental services and systems must be considered part of the design and implemented with it.

These principles also apply to the development of an integrated organization. There will be, however, many conflicting ideas of which staff member is responsible for the accomplishment of each specific function. For example, under the existing scheme, Estimating will usually be responsible for doing material take-offs during the pre-award phase, but the trades must repeat the effort during pre-production. This is, in fact, a duplication of effort. Similarly, upper management usually has at least one extra tier of middle managers between themselves and the trades. As a result, the time required for clear communication is lengthened unnecessarily.

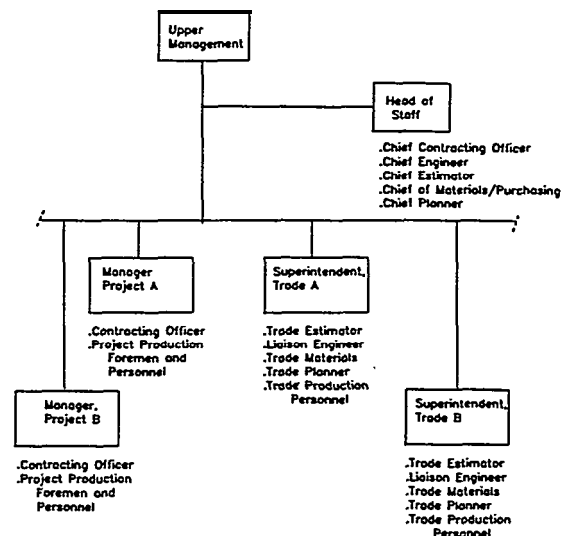


Figure 3
Organization of
an Integrated Shipyard

Implementing

Figure 3 is one organization chart for an integrated shipyard, showing several structural differences from the organization of the generic yard discussed earlier. To begin with, the lines of communication between upper management and each project are considerably shortened. Then, although upper management retains a small staff to provide an overview of key functions such as materials, planning and estimating, most of the personnel are reassigned to trade organizations. Next, the trade general foreman is responsible for providing estimates, schedules, and material support to both marketing and project managers. He is also responsible for augmenting the staff. In short, the trade general foremen become the focal point of all staff and personnel support for individual projects.

For example, if the staff responsibilities are assigned to the trade general foremen, and if the organization is designed to be supplemented by adequate data processing systems, the original material take-off done during proposal preparation could be used for rebidding, then reused to print out purchase orders.

The transition from the modern American shipyard to the integrated American shipyard will be a fairly lengthy one; many members of the current staff will decide that, under the new system, they will be unable to perform as they have in the past. The transition period will give them time to voluntarily seek other employment, reducing the number of lay-offs which finally must be made. Obviously, the shipyard cannot simply shut down for the transition period, so employees should be aware that this will be a time of change.

Summary

Using flow charts and generalized examples, this paper provides a brief outline of some staff-related problems which currently exist in American shipyards and suggests four steps to eliminate those problems by integrating the staff and providing it with adequate tools. These steps are: evaluating, communicating, consolidating and implementing. In the specific organization postulated by Figure 3, the staff functions are largely transferred to the trade organization to eliminate redundancy and shorten the lines of communications. Depending upon the individual shipyard, alternate solutions may be more advantageous. It is clear, however, that since the productivity of the entire shipyard is based on the skill and care with which the staff does their work, development of the staffing plan requires careful planning and implementation to improve overall performance.

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